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P01/7700 0.00-0319438.8

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01.	Your reference	RJB/P410282GB
2.	Patent application number *(The Patent Office will fill in this p*	0319438.8
3.	Full name, address and postcode of the or of each applicant (*underline all surnames*)	**CRP Group Limited,** Stanley Way, Stanley, Skelmersdale, Lancashire WN8 8EA
	Patents ADP number (*if you know it*)	06865364001
	If the applicant is a corporate body, give the country/state of its incorporation	ENGLAND
4.	Title of the invention	FAIRING
5.	Name of your agent (*if you have one*)	**W.P.THOMPSON & CO.**
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Coopers Building, Church Street, Liverpool, L1 3AB.
	Patents ADP number *(if you know it)*	0000158001 ✓

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(Day/month/year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application		Number of earlier application	Date of filing *(Day/month/year)*
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'yes' if:* *a) any applicant named in part 3is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	YES		

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Continuation sheets of this form	
Description	8
Claims(s)	4
Abstract	1
Drawing(s)	3 X

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Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	*1*
Request for substantive examination *Patents Form 10/77*)	
Any other documents *(Please specify)*	

11. I/We request the grant of a patent on the basis of this application

Signature Date 18 August 2003

W. P. Thompson & Co

12. Name and daytime telephone number of person to contact in the United Kingdom

R.J.BARTLE
0151-709-3961

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DESCRIPTION

FAIRING

The present invention relates to a fairing for mounting upon a cylindrical underwater member such as a marine riser.

In fact the present invention has been developed for use in connection with marine risers used in offshore oil extraction, although it has potential applications in other situations in which a submersed, cylindrical member is exposed to water flow and must be protected from the effects thereof.

Water currents impinging on marine risers create two particular problems. Firstly they create drag, i.e. a lateral loading upon the riser, producing undesirable bending stresses and potentially also increasing loads at the riser's point of suspension. Secondly they can create so-called vortex induced vibration (VIV). Vortices are found to be shed alternately from opposite sides of the riser and the effect can be to produce vibration which is potentially damaging, particularly if resonance effects cause the vibration's amplitude to build up.

It is known to address both problems by placing around the riser a streamlined, teardrop shaped fairing which is free to pivot about the riser's axis and so to "weathervane" - that is, to align itself with the direction of the current. Examples of such fairings are provided in US patents 5722340 (Sweetman), 40786605 (Jones), 4398487 (Ortloff), 4474129 (Watkins), 6067922 (Denison), 4171674 (Hale) and in published UK patent application GB2334733 (Reading and Bates Development Co).

A successful fairing must address several technical challenges:-

i. It should be capable of being straightforwardly fitted to the riser;

ii. It must be capable of surviving the marine environment;

iii. It must be capable of reliably weathervaning, since if the fairing becomes fixed in a position transverse to the flow then its effect on both drag and VIV may be positively deleterious; and

iv. It should preferably be capable of straightforward and economical manufacture.

The present invention is intended to provide a novel and improved solution to the technical challenges.

In accordance with a first aspect of the present invention there is a fairing for mounting upon a cylindrical member for underwater deployment, the fairing comprising a substantially wedge shaped fairing body which tapers from a front face of the body to its trailing edge, and at least one collar coupled to the fairing body and arranged to receive the cylindrical member and to mount the fairing upon the cylindrical member with the fairing body's front face adjacent the cylindrical member, the collar permitting the fairing to rotate about the cylindrical member and so to align itself with a water current.

Preferably a bearing surface of the collar, which faces toward the cylindrical member and

upon which the collar rides, comprises low friction material. The surface may be self lubricating. It is particularly preferred that the collar comprises a plastics material with an admixture of a friction reducing agent.

Preferably the collar comprises self lubricating material. The collar preferably comprises a plastics material with an admixture of an anti-fouling agent.

It is particularly preferred that the fairing body and the collar are formed by separate plastics mouldings.

Preferably the collar has two ends at least one of which is initially free to allow the cylindrical member to be inserted into the collar.

The free end of the collar is preferably able to deform, the ends of the collar being drawn apart, to receive the cylindrical member.

It is particularly advantageous to arrange that a portion of the collar is interposed between the fairing body and the cylindrical member in use, maintaining a separation therebetween.

In a preferred embodiment the collar comprises two bifurcated portions, one limb of each extending between the cylindrical member and the fairing body to maintain the separation and the other limb of each being secured in use to the fairing body.

Preferably the fairing body's front face is substantially part cylindrical and concave, to

complement the shape of the cylindrical member.

Preferably the fairing is shaped such that, when the fairing is mounted upon the cylindrical member, the assembly has a substantially teardrop shaped cross section whose leading edge is formed by the cylindrical member.

The fairing body is preferably formed as a hollow plastics moulding whose interior communicates with the exterior to permit equalisation of pressure.

In accordance with a second aspect of the present invention there is a clamp for mounting fairings upon a cylindrical underwater member, the clamp forming a cylindrical cavity to receive the member, being adapted to be immovably secured upon a member in the cavity, and having at its exterior a pair of cylindrical spigot portions projecting from either side of a flange portion, so that fairings on either side of the clamp can ride upon the spigot portions and be axially located by engagement with the flange portion.

The clamp and fairing would typically be supplied to the user as a kit of parts.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which :-

Figure 1 is a perspective illustration of an assembly comprising a first fairing embodying the present invention mounted upon a marine riser;

Figure 2 is a side elevation of the same assembly;

Figure 3 is a section through the assembly at station A-A;

Figure 4 is a section through the assembly at station B-B;

Figure 5 is a perspective illustration of a collar forming part of the fairing;

Figure 6 is a section in a longitudinal plane through an assembly comprising a clamp and a fairing both embodying aspects of the present invention mounted upon a marine riser; and

Figure 7 is a section through the same assembly in a transverse plane.

The fairing 2 illustrated in Figures 1 to 5 comprises (a) a fairing body 4 and (b) a plurality of collars 6 serving to rotatably couple the fairing body 4 to a cylindrical marine riser 8.

The fairing body 4 can be seen to be generally wedge shaped. Its front, lying adjacent the riser 8, has a lateral dimension similar to that of the riser. In the illustrated embodiment this dimension is slightly smaller than the riser diameter. Moving toward its rear the fairing body tapers to a narrow trailing edge 10. The front face 12 of the fairing body is shaped to conform to the adjacent surface of the riser, being part cylindrical and concave. The cross section which the assembly of riser and fairing presents to a current of water is best appreciated from Figure 3, where it can be seen that the assembly's leading edge 14 is formed by the riser itself and that the whole assembly forms a streamlined teardrop shape. In a manner which will be wholly familiar to the skilled person, this shape tends to maintain laminar flow and serves both to reduce drag (i.e. lateral loading upon the riser due to the current) and to prevent or

reduce VIV.

The illustrated embodiment has a pair of identically formed collars 6,6' at opposite ends of the fairing body. In Figure 5 it can be seen that each collar comprises a bearing ring 16 which is split at 18 to allow the riser 8 to be introduced laterally into the bearing ring. The collar is formed of a resiliently deformable material so that the ring can be opened out - that is, ends of the ring on either side of the split 18 can be drawn apart - to allow the riser to be introduced. In the present embodiment this deformation of the collar is facilitated by a reduced thickness region 20 which serves as a resilient hinge. At 22,24 the collar has a bifurcated section. One limb 26, 28 leading from each bifurcation forms part of the bearing loop and in use lies between the fairing body and the riser (see Figure 4) while the other limb 30, 32 extends in a direction generally parallel to an adjacent face 34, 36 of the fairing body and forms a mounting tab through which the collar is mounted to the fairing body.

As seen in Figure 3, the fairing body has shallow recesses or pockets in which the mounting tabs are received, so that the tabs' outer surfaces are generally flush with the adjacent faces 34, 36 of the fairing body (see Fig. 3). Attachment of the tabs to the fairing body is achieved using mechanical fasteners received by through-holes 38, 40 in the tabs which align with holes in the fairing body. The fasteners shown in the drawings are formed as nuts and bolts 42. In order to resist corrosion and minimise weight these may be formed of plastics. However it is anticipated that during refinement of the product some other form of plastics fastener such as a plastics rivet is likely to replace the nuts and bolts. The fairing may be supplied to the end user with the tabs on one face 34 pre-attached so that to mount the fairing the user first inserts the riser into the collars and then secures the relevant tabs to the other

face 36.

The fairing body is formed by a single plastics moulding. More specifically the illustrated item is manufactured by the well known technique of rotational moulding, so that it is hollow. Polythene is the preferred material for this component, which is advantageous due to its low specific gravity (similar to that of water), toughness and low cost. An opening 44 allows water to enter the fairing body to equalise internal and external pressures. The body could instead be formed as a solid polyurethane moulding. The collars are each formed by a single plastics moulding but for these the favoured material is nylon, which again has a specific gravity similar to that of water.

It will be apparent that the internal face 44 of the collar's bearing ring 16 serves as one half of a rotary bearing allowing the fairing to rotate about the riser's longitudinal axis and so to weathervane to face a current. The present inventor has recognised that it is highly desirable for this bearing surface to be (a) low friction and even "self lubricating" and (b) resistant to marine fouling. These properties can be promoted by incorporation of anti-fouling and friction reducing materials into the material of the collar. In the illustrated embodiment the plastics material of the collar contains an admixture of an anti-fouling composition which provides a controlled rate of release of copper ions, whose biocidal properties are well known, and also of silicon oil serving to reduce bearing friction.

The internal part of the bearing on which the fairing is mounted may be provided by the riser itself. That is, the fairing may be mounted directly upon the riser (or on a cylindrical protective sheath conventionally provided around the riser). A number of such fairings would

normally be placed adjacent one another in a string along the riser. To prevent the fairings from moving along the length of the riser, clamps are secured to it at intervals (typically a string of perhaps five fairings would be confined between a pair of clamps). The clamps may be of a type well known in the context having a pair of half cylindrical clamp shells secured to the riser by a tension band passed around the shells.

An alternative arrangement can be understood from Figures 6 and 7 in which a clamp formed by two half cylindrical clamp shells 50, 52 is secured to the riser, again labelled 8 in this drawing, by a tension band 54 received in a shallow annular recess in the exterior of a central flange 56 formed by the clamp shells from either side of which project reduced diameter spigot portions 58 upon which the collars 60, 62 of respective fairings, arranged on opposite sides of the clamp, ride. The drawing is simplified in that remaining parts of the two fairings are omitted (they can be taken to be similarly formed to those of the previous embodiment). While only a single clamp is shown in the drawing, it is to be understood that in this arrangement a clamp is provided between each adjacent pair of fairings, so that the fairings' rotary bearings are in each case formed by a collar riding upon the clamp.

CLAIMS

1. A fairing for mounting upon a cylindrical member for underwater deployment, the fairing comprising a substantially wedge shaped fairing body which tapers from a front face of the body to its trailing edge, and at least one collar coupled to the fairing body and arranged to receive the cylindrical member and to mount the fairing upon the cylindrical member with the fairing body's front face adjacent the cylindrical member, the collar permitting the fairing to rotate about the cylindrical member and so to align itself with a water current.

2. A fairing as claimed in claim 1 wherein a bearing surface of the collar, which faces toward the cylindrical member and upon which the collar rides, comprises low friction material.

3. A fairing as claimed in claim 2 wherein the bearing surface comprises self lubricating material.

4. A fairing as claimed in claim 3 wherein the collar comprises a plastics material with an admixture of a friction reducing agent.

5. A fairing as claimed in any preceding claim wherein the collar comprises an anti-fouling agent.

6. A fairing as claimed in any preceding claim wherein the collar comprises a plastics material with an admixture of an anti-fouling agent.

7. A fairing as claimed in any preceding claim wherein the fairing body and the collar are formed by separate plastics mouldings.

8. A fairing as claimed in any preceding claim wherein the collar has two ends at least one of which is initially free to allow the cylindrical member to be inserted into the collar.

9. A fairing as claimed in claim 8 wherein the free end of the collar is adapted to be secured by a mechanical fastener to retain the fairing upon the cylindrical member.

10. A fairing as claimed in claim 8 or claim 9 wherein the collar is able to deform, the ends of the collar being drawn apart, to receive the cylindrical member.

11. A fairing as claimed in any preceding claim wherein a portion of the collar is interposed between the fairing body and the cylindrical member in use, maintaining a separation therebetween.

12. A fairing as claimed in claim 11 wherein the collar comprises two bifurcated portions, one limb of each extending between the cylindrical member and the fairing body to maintain the separation and the other limb of each being secured in use to the fairing body.

13. A fairing as claimed in any preceding claim wherein the fairing body's front face is substantially part cylindrical and concave, to complement the shape of the cylindrical member.

14. A fairing as claimed in a any preceding claim which is shaped such that, when the fairing is mounted upon the cylindrical member, the assembly has a substantially teardrop shaped cross section whose leading edge is formed by the cylindrical member.

15. A fairing as claimed in any preceding claim wherein the fairing body is a hollow plastics moulding whose interior communicates with the exterior to permit equalisation of pressure.

16. A fairing as claimed in any preceding claim which is substantially neutrally buoyant.

17. A fairing as claimed in any preceding claim having two collars spaced apart from each other.

18. A clamp for mounting fairings upon a cylindrical underwater member, the clamp forming a cylindrical cavity to receive the member, being adapted to be immovably secured upon a member in the cavity, and having at its exterior a pair of cylindrical spigot portions projecting from either side of a flange portion, so that fairings on either side of the clamp can ride upon the spigot portions and be axially located by engagement with the flange portion.

19. A kit of parts comprising a set of clamps as claimed in claim 18 and a set of fairings as claimed in any of claims 1 to 17.

20. A fairing substantially as herein described with reference to, and as illustrated in, accompanying Figures 1 to 5.

21. A clamp for mounting fairings substantially as described with reference to, and as illustrated in, accompanying Figure 6 and 7.

ABSTRACT

FAIRING

A fairing is disclosed for mounting upon a cylindrical member which is deployed underwater. The fairing has a generally wedge shaped body 4 which tapers from front to rear. The body 4 is mounted upon the cylindrical member 8 through a collar 6, 6 [1] in which the member is received. The fairing is thus mounted with its front face adjacent the cylindrical member
so that the assembly of the fairing body and the member can together form a teardrop shape. The collar permits the fairing to weathervane, rotating about the cylindrical member, to align itself with a current.

Figure 1.

Fig. 1

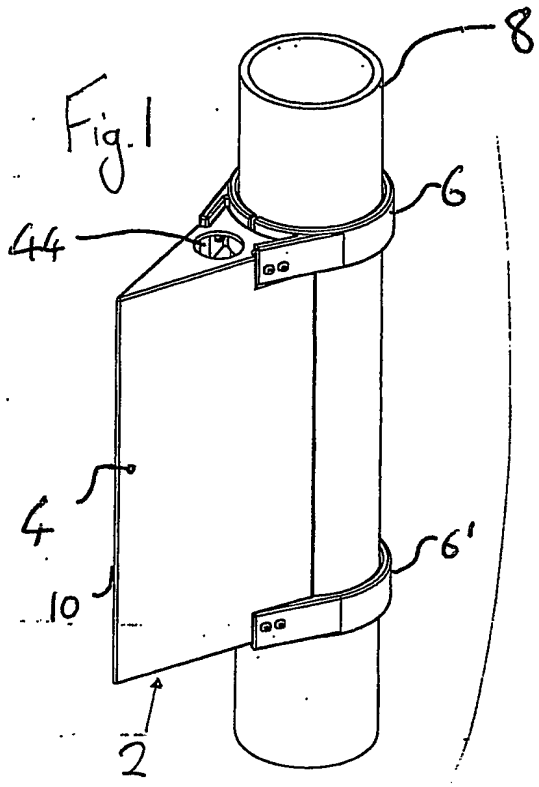

Fig. 2

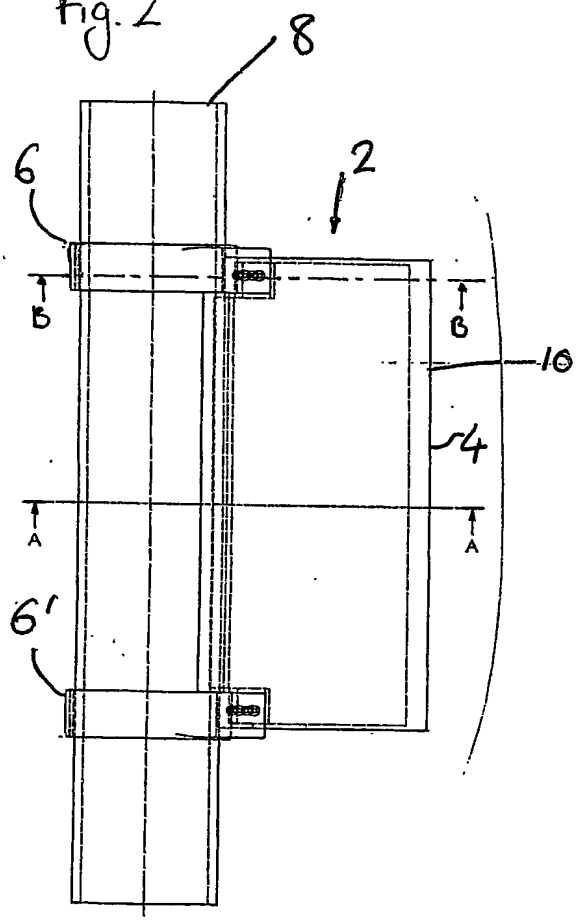

Fig. 3

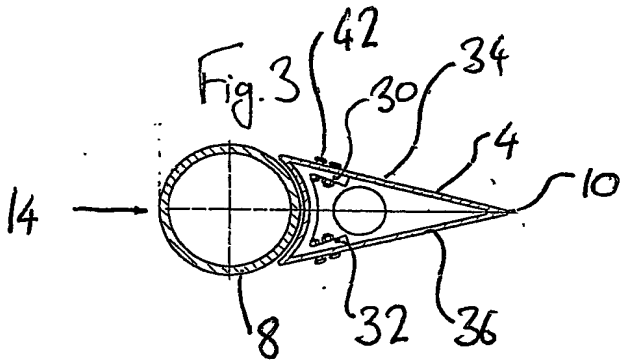

Fig. 4

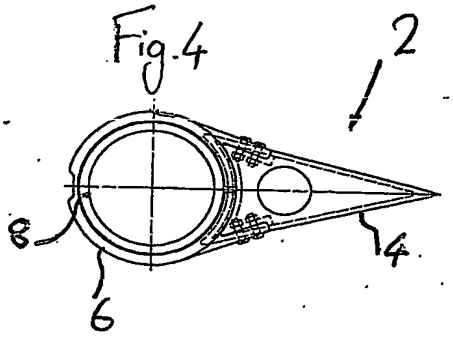

Fig.5

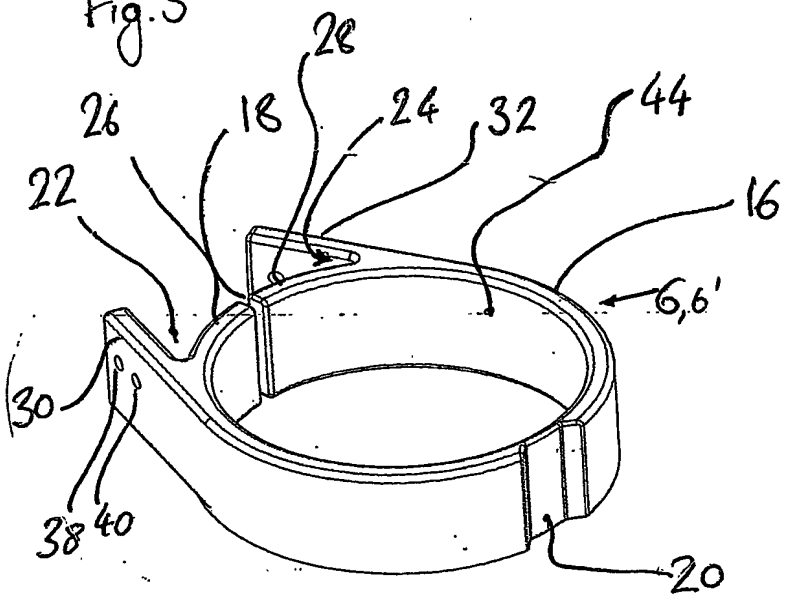

Fig. 6

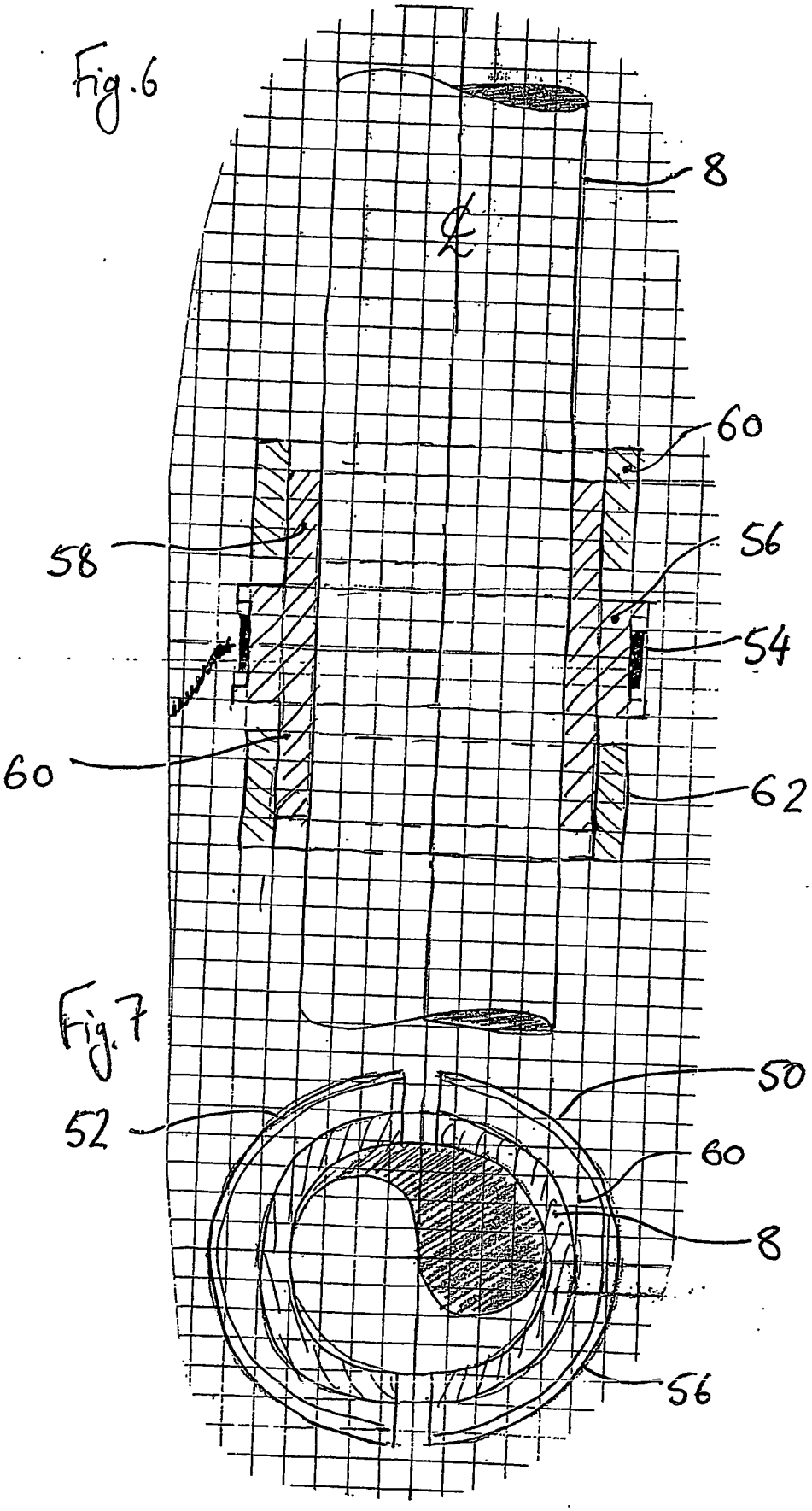

Fig. 7